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REPORTING ON SUSTAINABLE DEVELOPMENT IN SUPPORT OF NATIONAL DECISION-MAKERS

by

François Bregha, John Moffet and Vic Nishi

Resource Futures International

March 1993

Unedited Working Paper for Discussion

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For comments or copies please contact:

National Round Table on the Environment and the Economy (NRTEE)

1 Nicholas Street, Suite 1500
Ottawa, Ontario, K1N 7B7
Ph: (613) 992-7189 Fax: (613) 992-7385

pour commentaires ou exemplaires contacter:

Table ronde nationale sur l'environnement et l'économie (TRNEE)

1, rue Nicholas, bureau 1500
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REPORTING ON SUSTAINABLE DEVELOPMENT IN SUPPORT OF NATIONAL DECISION-MAKERS

March 24, 1993

Resource Futures International

Submitted to

the Task Force on Sustainable Development Reporting

of the

National Round Table on The Environment and the Economy

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FOREWORD

This is one of four background reports on sustainable development reporting prepared for the Task Force on Reporting of the National Round Table on Environment and Economy. The other three reports focus on the needs of the individual and householders, communities and municipalities, and the business sector. The purpose of each of these reports is to assess current Canadian ability to undertake effective reporting on progress towards sustainable development.

Each of these reports has been written on the basis of a conceptual framework developed by Tony Hodge which identifies three domains of data for sustainable development reporting:

- monitoring and assessing the state of the human subsystem
- monitgoring and assessing the human-ecosystem interface
- monitoring and assessing the state of the ecosystem

The terms of reference for this project specified a set of topics in each of these domains for investigation. These topics are addressed in the body of the report. Interviews, and file and documentary reviews were the primary research tools used to gather information.

The National Round Table Task Force on Reporting will draft its own report and recommendations on the basis of the four background reports.

This report on national decision-makers was drafted by François Bregha, John Moffet and Vic Nishi, with the assistance of Marjory Loveys.

1. INTRODUCTION

Information, presented in a comprehensible, balanced, accurate and timely manner, is the indispensable base upon which sound policy-making rests. In the mid-1980's, the federal government spent three quarters of a billion dollars annually and employed over 10,000 persons in collecting basic information about Canada, its people, its economy, its natural resources and its environment. It was estimated that the provinces spent a further $125 to $150 million per year at that time (Major Surveys Study Team, 1985).

The Major Surveys Study Team noted in 1985 that "there is a striking difference between the ways in which the economic surveys and the environmental and natural resource surveys are organized, how they receive their policy direction and set priorities". Statistics Canada is the lead agency in collecting socio-economic information. Its mandate is clear, in part because the federal government's responsibilities over economic policy are clear. The responsibility for collecting information on the environment and natural resources, however, is shared among many government agencies. This fragmentation reflects the historical division of jurisdiction among federal departments. The Major Surveys Study Team noted that this institutional arrangement has militated against the integration of information concerning the environment and natural resources. Furthermore, the absence of widely-accepted indicators of environmental health have made it more difficult to determine what and how much to survey.

In response to the report of the World Commission on Environment and Development, an increasing number of governments and international organisations have endorsed the concept of sustainable development to guide their policies and programmes. The Canadian government launched Canada's Green Plan in 1990 as a national blueprint to promote more sustainable forms of development.

Sustainable development is an integrative concept which incorporates economic, environmental and socio-cultural perspectives into an holistic understanding of development. The concept of sustainable development redefines the policy questions which governments need to answer and, hence, their information needs. The governments' "standard agenda" applies a sectoral approach to policy-making. Institutional arrangements parallel and reinforce this division of responsibilities: thus, the department of energy is responsible for energy policy (typically, increasing energy supply), the department of fisheries manages fish stocks, the department of environment controls pollution, and so on. Policy-makers have traditionally defined their information needs to reflect these mandates. The information they have accumulated has been similarly compartmentalised.

As we have come to understand better the many links between environmental quality, human health, social well-being and economic prosperity, we have become aware of the need to pursue an "alternative agenda", one which explicitly integrates al of these dimensions of development. Not surprisingly, governments are finding that many of the information systems which served them well in meeting the needs of the standard agenda are deficient in helping them address this "alternative agenda".

Thus, governments have accumulated considerable information on soil degradation, nitrate pollution of groundwater and the eutrophication of surface waters in order to resolve each of these problems. They have collected far less of the information needed to anticipate and prevent these problems by reformulating the agricultural policies which cause them. Governments have been collecting information on the effects of environmental problems rather than on their root causes. They have collected economic, social and environmental information in isolation.

As the World Commission on Environment and Development put it, "the ability to choose policy paths that are sustainable requires the ecological dimensions of policy to be considered at the same

time as the economic, trade, energy, agricultural, industrial and other dimensions -- on the same agendas and in the same national and international institutions. This is the chief institutional challenge of the 1990's".

The way in which governments collect information leads to the paradox described by Brown (1991) of mutually incompatible descriptions of wellbeing: while economists point to increasing standards of material welfare, ecologists document the dangers to the planet's life-support systems posed by rising affluence and increasing population.

Brown writes that

> these contrasting views of the state of the world have their roots in economics and ecology -- two disciplines with intellectual frameworks so different that their practicioners often have difficulty talking to each other. ...This schizophrenic perspective is translating into intense political conflict in economic policy-making. To the extent that constraints on economic expansion are discussed on the business pages, it is usually in terms of inadequate demand growth rather than supply-side constrainsts imposed by the earth's natural systems and resources. In contrast, the ecological view ... holds that continuing the single-minded pursuit of growth will eventually lead to economic collapse. Ecologists see the need to restructure economic systems so that progress can be sustained.

The concept of sustainable development challenges the prevailing economic paradigm and the widely-used materialistic definitions of human welfare. This paper does not explore the policy implications of this challenge. Rather, it focuses on the information decision makers need to formulate and implement sustainable development strategies. One of the issue that the application of sustainable development strategies raises is how to integrate measurements of ecosystem well-being with human well-being, in other words, how to resolve the paradox presented above.

The way in which policy-makers define sustainable development will determine their requirements for information. Sustainable development is a normative concept implying trade-offs among economic, environmental, social, cultural, ethical and other values. Decision makers are likely to require different information if they emphasise achieving intergenerational equity as opposed to, say, improving the efficiency of the market in a sustainable development strategy.

It should be noted that sustainable development indicators, that is indicators which integrate all the various dimensions of the concept, may not exist as such. Many indicators which combine two dimensions (e.g., energy efficiency is an economic indicator with implicit environmental values) exist. In most cases, however, progress towards sustainable development may have to be measured on the basis of indicators culled from the "traditional" disciplines of economics, sociology and ecology.

The State of Oregon has developed an innovative planning system to measure the State's progress in education, health care, environmental quality, community quality of life and economic opportunity. It has identified indicators in each of these areas, called benchmarks. Although not described as sustainable development indicators, these benchmarks represent much of the information required to assess the effectiveness of a sustainable development strategy. "The purpose of Oregon Benchmarks is to guide our state to a better future as a people, as a place, and as an economy. ...By keeping track of whether we are measuring up, we are more likely to sustain the focus and energy that will be required to bring our dreams to fruition". (Oregon Progress Board, 1992)

The survey below provides an overview of the information which the federal government now commands in making decisions. It is not comprehensive. Using illustrative examples, it contrasts

the health, social, economic and environmental information available to governments against an ideal needed to gauge progress towards more sustainable forms of development. The survey is organised as follows: Section 2 reviews the status of indicators related to human well-being. Section 3 examines indicators related to eco-system well-being. In Section 4, we discuss indicators related to the interface between the human and the ecological systems. In Section 5, we present concluding observations on the information available to reporting progress on sustainable development in Canada.

2. HUMAN SUBSYSTEM

The aim of development should be to improve the quality of human life. Sustainable development thus requires a focus on human and social development, in addition to economic factors and ecological sensitivity. As the Human Development Report 1991 of the United Nations Development Program put it, "men, women, and children must be the center of attention - with development woven around people, not people around development" (UNDP, 1991).

This broad perspective on human well being suggests that economic growth is only a part of development. Low correlations between GNP and social indicators and between income and personal satisfaction indicate that economic data alone are insufficient to portray accurately social and human well being (WRI et al, 1992).

The UNDP has developed a "human development index", based on indicators of longevity, knowledge and living standards (UNDP, 1991). Similary, in Caring For the Earth, the World Conservation Union, the United Nations Environmental Program and WWF, argue that health care, education, population stabilization, peace, personal security, political freedom and social well being are critical components of sustainable development, in addition to individual and community income levels (IUCN et al, 1990). Many authorities argue that sustainable development also requires increased local participation in development decisions, both to ensure the success of development efforts, and to empower individuals (IUCN et al, 1990; WRI et al, 1992).

Ideally, the Canadian government would have access to information on this wide spectrum of indicators. Individual data sets, focused on health, economics, demographics, justice, etc. should be linked to form overall measures of well being. These links should reflect environmental, social and economic impacts. In addition, sustainable development requires a focus on distributional equity - both for future generations, and for the current one. This information should also facilitate and encourage an analytical focus on both geographic and temporal distributional issues. Finally, the government should also have the capacity to use this information to enhance its ability to increase the broad dimensions of human development discussed above.

2.1 Health

The Ideal

In 1948 the World Health Organization (WHO) defined health as "a state of complete physical, mental and social well being, and not merely the absence of disease or infirmity". In 1986, the WHO, Health and Welfare Canada (HWC) and the Canadian Public Health Association (CPHA) sponsored a conference on health promotion. The conference promulgated the Ottawa Charter for Health Promotion, which took the WHO definition of health as its starting point, and emphasized that health depends on the interaction of individuals with their social environment and their physical environment (WHO, HWC and CPHA 1986). The Charter lists a number of prerequisites to health, including peace, shelter, education, food, income, social justice, equity, maintenance of a stable ecosystem and sustainable resource development.

The Ottawa Charter outlines five broad strategies for health: healthy public policy; supportive environments; community action; personal skills; and reoriented health services. In 1989, the Ontario Premier's Council on Health Strategy adopted five similar strategies: to shift the emphasis to health promotion and disease prevention; to foster strong and supportive families and communities; to ensure a safe, high quality environment; to decrease morbidity and mortality rates; and to enhance access to health services.

Ideally, data would be available to government decision makers to help them understand the independent and collective importance and status of each of these determinants of health in a rigorous manner. Data should also be available both to explain and help manage the social institutions affecting human well being.

Current Information

Governments in Canada collect a vast range of health related information. The National Health Information Council (NHIC) is an intergovernmental council, designed to ensure cooperation among all levels of government in collecting health information. The NHIC Secretariat is quartered in and funded by Health and Welfare Canada. The largest source of information is the Canadian Center for Health Information (CCHI), located within Statistics Canada. NHIC and CCHI have embarked on a number of projects, including the development of key health indicators and an inventory of health information systems.

CCHI produces a number of documents, including the Canadian Health Indicators Database. To date, about 60 indicators have been developed by a joint federal-provincial process. These indicators provide four categories of information: health status, health resources, health resource utilization, and health determinants. With the exception of the latter category, most of the data falls into the traditional medical model of health, focused on the absence of disease, and provides little information on other aspects of health.

The NHIC also assists the Canadian Coordinating Committee for Health Technology Assessment and the Canadian Center for Occupational Health and Safety (CCOHS), a tripartite organization, representing governments, unions, and employers. Both organizations collect and disseminate specific information. The CCOHS has a CD ROM data base that is widely utilized by its constituents.

CCHI also conducts health status surveys, including the 1978 Canada Health Survey. The next Federal survey is scheduled for 1994. Other, smaller, more specific surveys are conducted by Statistics Canada, primarily for Health and Welfare Canada. Both Ontario (1990) and Quebec (1987 and 1993) have also conducted major health status surveys. No other province has recently conducted similar surveys, and apparently all others intend to wait for the results of the 1994 Canada Health Survey.

Various divisions and arms-length organizations associated with Health and Welfare Canada (HWC) also collect and disseminate health information. While CCHI - as a part of Statistics Canada - collects information for general use, HWC collects information primarily to assist with its own work. For example, the Health Promotions Directorate, the Policy, Planning and Information Branch, the Canadian Fitness and Lifestyle Research Institute, and the Canadian Coordinating Committee for Health Technology Assessment collect and aggregate data on specific issues, and occasionally also commission surveys, including the 1986 Health Promotion Surveys, and various Health and Activity Limitations Surveys. In addition, the Laboratory Center for Disease Control collects epidemiological data.

Provincial health ministries collect considerable information about the resources used by health care. However, very little information is available about the health benefits produced, or the

relationship between resources and health benefits. Currently, such information is collected in a relatively ad hoc manner by discrete epidemiological studies, most of which are carried out within teaching hospitals.

Issue and Recommendations

a. Problems with Current Information

Despite -- and in part because of -- the large amount of data described above, the National Task Force on Health Information concluded in 1991 that health information in Canada was in a "deplorable" state. This situation results from conceptual uncertainty, scientific complexity, and institutional coordination problems.

i. Conceptual Uncertainty

Current efforts to collect information about and report on health status are impeded by the absence of an accepted conceptual framework which links information about the determinants of health with an evaluation of health status. Efforts to develop adequate indicators of human well being are underway at all levels of government. The National Task Force on Health Information (1991) attempted to develop a conceptual framework for health indicators in Canada. As noted above, the CCHI continues to work on this issue. Similarly, in Ontario, the Premier's Council on Health, Well Being and Social Justice, the Premier's Council on the Economy and Quality of Life, and the Ministry of Communication's new Heritage Strategy have each elaborated definitions of well being.

In recognition of the links between the environment and human health, the federal government co-sponsored a series of workshops between 1987 and 1991 on the "Health Aspects of Environmental Impact Assessment" (CEARC et al, 1990). In 1992 HWC published A Vital Link: Health and the Environment in Canada. In the same year the CPHA published Human and Ecosystem Health, laying out a strategic framework for addressing issues relating health and sustainable development. Each of these initiatives further emphasizes the need to link human economic, social and environmental factors in assessing human well being.

The Healthy Cities Movement has also attempted to provide a new conceptual basis for health indicators. As a result of this movement, a number of Canadian cities have considered or completed a "state of the city report", emphasizing the relationship between the community, the environment and the economy.

The final important contribution to this issue is provided by the Canadian Institute for Advanced Research (CIAR). The Program in Population Health was established at CIAR in 1987 to advance understanding of the factors influencing health status, and has resulted in the development of models that seek to link the social environment, the physical environment, prosperity, genetic endowment, overall well being, individual response, disease, and health care (Evans and Stoddart, 1990).

ii. Scientific Complexity

Even within the most coherent of the conceptual frameworks discussed above, the development of effective health indicators is constrained by scientific uncertainty and technical complexity. A fundamental problem is lack of information. For example, in 1992 the CPHA observed that there is adequate toxicological information to conduct a health hazard assessment of only about 20% of the 70,000 plus chemicals in common use in North America (CPHA, 1992). The environmental issue that most directly affects the majority of Canadians is the effect of pollutants on human

health. However, knowledge of the health effects of many contaminants is still rudimentary, and based on only a limited number of cases (SOE, 1991: 27-14; HWC, 1992).

The traditional tools for tracking public health effects, toxicology and epidemiology, have important limitations (Davies, 1992). There is also inadequate information about the various public health and health promotion activities undertaken by all levels of government. Few such activities are adequately evaluated. Without this information, it is impossible to determine appropriate health policy, particularly if one accepts the broad definitions of public health elaborated above.

Although governments are starting to appreciate the importance of the link between health and the economy, efforts to inform public policy are undermined by inadequate information. There is strong evidence of a connection between such factors as education and income levels and morbidity and mortality rates (Wolfson, 1993). There is also some information suggesting that healthy lifestyles can improve productivity, lower absenteeism and reduce health costs (CPHA, 1992). However, there is little evidence about the nature of these relationships. In addition, this information has not been widely disseminated. Nonetheless, governments are beginning to focus on these issues. The Ontario Premier's Council on Health recent publication "Nurturing Health" echoes an earlier policy from the Quebec Ministry of Health and Welfare in suggesting that more research be devoted to these issues.

As a result of each of these inadequacies, most policy makers and individual citizens continue to believe that medical institutions are the most important guarantor of health, when in fact, most medical institutions limit their activities to the ex post treatment of disease. The maintenance of good health depends instead on lifestyle, environmental and community factors, each of which is amenable to public policy, but few of which are currently linked to health through contemporary health indicators.

iii. Institutional constraints

Both the Health Aspects of Environmental Impact Assessment and the report from the National Task Force on Health Information emphasized that poor coordination of the highly fragmented responsibility for health, environmental, and economic information -- between jurisdictions, and among departments in any given jurisdiction -- is a major impediment to the development and promulgation of effective health indicators.

There are also institutional disincentives to the generation of good data. Traditionally, most epidemiological research occured at teaching hospitals. However, teaching hospitals are primarily concerned with the treatment of disease, and consequently have little incentive or capacity to focus on disease prevention or health maintenance. This narrow focus is somewhat offset by work that has recently been conducted at Statistics Canada, at universities, and at some teaching hospitals that focusses on more general epidemiological issues. On the other hand, the narrow focus is perpetuated to a certain extent by the traditional focus of the Medical Research Council, the primary source of funding of epidemiological research at teaching hospitals. In addition, an important proportion of the funding for epidemiological research comes from pharmaceutical companies seeking approval for new drugs. This funding inevitably influences research agendas, diverting effort from the broad focus advocated by the Ottawa Charter, for example.

As a result of these concerns, the federal government is in the process of establishing a new institute to replace the NHIC. Current efforts focus on the critical institutional coordination problems. In addition, it is hoped that the new institute will provide a central forum to resolve the many conceptual problems related to the development of effective health indicators.

b. Recommendations

At least four developments are required to improve health information. First, the institutional constraints must be reduced. In this regard the new health information institute currently being established by Statistics Canada and HWC will be very important. Second, as noted above, a new conceptual framework for health information is required. Health information should reflect the more comprehensive understanding of the determinants of well being described by the Ottawa Charter, and, in particular, should emphasize the links between health, economics and the environment. Considerable work has been done on clarifying the conceptual framework for health information, in particular, by Statistics Canada and by CIAR. In addition, both the Manitoba Center for Health Policy and Evaluation at the University of Manitoba and CCHI have attempted to develop systems of health statistics based upon the determinants of health. Third, administrative and household data should be merged. A number of provinces, including Quebec, Manitoba, Saskatchewan and B.C., are now developing systems to link records of hospital visits to individuals. These initiatives should improve tracking of individual use of medical resources. Finally, an overall health outcomes index is required to link benefits and treatments. Statistics Canada is currently working on a computer model to permit assessment of the health status of the Canadian population (Wolfson, 1991). However, without continued improvement in the three areas discussed above, this model will not be effective.

2.2 Economic and Employment Indicators

The Ideal

Like health data, economic data should be linked to overall measures of ecosystem and social well being. These links should reflect environmental and social impacts, as well as measures of economic performance.

Current Information

Information describing the Canadian economy is collected, aggregated and disseminated by various government and non-government entities. Finance Canada is responsible for providing economic advice to government. In this capacity, Finance determines which economic information will be important for government policy making. However, Finance Canada does not collect its own data. It primarily relies on Statistics Canada, but also receives information from the Bank of Canada, CMHC, the Canadian Real Estate Association, Labour Canada, and the OECD. Treasury Board and the Auditor General also produce information on the government's own economic status. Finally, the Conference Board of Canada, and to a lesser degree, a number of other independent institutions produce economic data that is influential both inside and outside government.

Statistics Canada is the principal source of economic data within government. It collects data on a vast range of topics, some very specific, and some highly aggregated. Statistics Canada provides data on income, employment, labour force characteristics, demographics, primary industries, manufacturing industries, the transportation sector, services, merchandising, international trade, balance of payments, international investments, commercial activities, and government financing.

The Department of Finance, the Bank of Canada, and Statistics Canada each publish a list of economic indicators on a regular basis. Finance Canada publishes the Quarterly Economic Review; Statistics Canada publishes the monthly Canadian Economic Observer; and the Bank publishes the monthly Bank of Canada Review and an annual report. Each of these reports interprets available economic data, and provides a different list of "Main" or "Primary" indicators. Essentially, however, each focuses on the following factors: GDP; inflation; factor unit costs; the value of the dollar; total domestic demand; employment data; and consumer spending. In addition, the Bank emphasizes monetary data, such as credit and debt information.

Both Finance Canada and Statistics Canada also publish working papers. These include updates on statistical issues, on for example, the development of a new composite Leading Indicator in 1992, or the work underway in Statistics Canada on integrating environmental and economic data. In addition, Finance Canada also reports on work it is doing on modeling environment-economy links.

In all of the above, neo-classical economic indicators such as price levels and GDP are the most influential measures of the effect of and need for public spending. The national and provincial economies are monitored through use of the system of national accounts (SNA) and their provincial counterparts. These accounts measure the value of Canada's total production of goods and services in terms of economic exchanges that occur in the marketplace. From the resulting integrated data base, aggregate numbers are derived such as gross national product (GNP) or gross domestic product (GDP), consumption expenditure, government expenditure, and national income. These aggregates are heavily relied upon for planning demand management and stabilization policies (Doern et al, 1988). The Provincial and Territorial accounts are also used as a basis for negotiations with the Federal government on matters involving inter jurisdictional transfers of funds (Hodge, 1991).

The importance of traditional economic data is evident in the budget processes. The budget statement and annual estimates process are the two most important regular policy initiatives taken by the Federal government. Current budget policies reflect a mix of Keynesian and monetarist policies. Despite important differences, the primary focus of both policies is on stimulating economic growth. This focus is reflected in the information relied upon in forming both the revenue and expenditure budgets. The empirical framework for both budgets is a macroeconomic analysis performed by the Department of Finance. This analysis is based almost exclusively on the traditional economic indicators described above (Doern et al, 1988).

Issues and Recommendations

a. Problems With Current Information

> i. Traditional economic indicators ignore the state of the environmental resource on which the economy is built, and provide only limited reference to social dimensions of well being.

Income accounting measures economic activity for which exchange occurs in monetary terms in a given time period. It can indicate the level of economic activity, its variations from year to year, the size of savings and investment, factor productivity, industrial structure, and comparable performance. These indicators are important, but do not present a complete measure of sustainable development. Traditional income accounting is deficient in several important respects, three of which are briefly outlined below.

- Traditional measures of productivity, such as output per person-hour, inaccurately reflect the value of R & D. For example, public expenditures on health research which lower the incidence of morbidity have little impact on national income figures. At first approximation, a decrease in morbidity would raise both GNP and hours worked, leaving output per person-hour largely unchanged.

- Aggregated economic indicators fail to account for a wide range of activities that have social value, including leisure, unpaid work and subsistence activities. In particular, the SNA, as currently constructed, do not account for the value of environmental amenities, let alone for ecological values.

- Finally, current national accounting procedures primarily reflect rates of consumption, and are therefore blind as to whether that consumption has been produced by the sustainable use of resources, or whether it has occurred at the expense of present or future environmental or social capital. The SNA therefore fail to account adequately for natural resource depletion, degradation, and protection. For example, man made assets are valued as productive assets, and are written off against the value of production as they depreciate. However, natural resource assets are not so accounted for, and their loss produces no charge in the national accounts against current income to reflect the decrease in potential future production. The SNA also misrepresent the costs and benefits of environmental protection. For example, these indicators treat expenses by governments on environmental protection as outputs rather than as inputs. On the other hand, commercial expenditures on environmental protection are included in the SNA, but the corresponding benefits of a cleaner environment are not. Conversely, where environmental protection expenses are not made, the resulting environmental damage is not counted as a cost.

Existing economic indicators thus measure only a limited portion of economic activity, and fail to reflect social welfare fully. They reflect the value system implicit in the macroeconomic conceptual framework that is rejected by sustainable development (Victor, Kay and Ruitenbeek, 1991). There are several schools of thought about the best way to resolve this accounting problem (UNEP-World Bank, 1989). To its credit, the Canadian Government is actively engaged in attempts to resolve the issue. For example, a number of countries, including Canada are in the process of establishing satellite environmental accounts, not explicitly linked to the SNA. The object is to use indicators of physical change to influence public opinion and environmental policies. Thus, Statistics Canada is developing a set of four inter-related accounts on natural resources and the environment: (i) natural resource stock accounts (quantities and values of natural resources); (ii) natural resource flow accounts (supply and disposition of natural resources in quantity and value); (iii) waste and pollutant output accounts (generation of unwanted byproducts by sector); and (iv) environmental expenditure accounts (expenditures on environmental protection by sector).

A number of prominent economists argue that environmental accounting will not have an adequate effect unless the accounts are monetized and integrated into the SNA. The argument is that the SNA are and will continue to be widely relied upon, and therefore it is imperative to produce an adjusted national income that is more sustainable. To this end, Statistics Canada is in the process of incorporating the monetary values of the natural resource stocks into the Canadian National Balance Sheet Accounts. Detractors argue that this proposal has three main problems. First, there may not be a satisfactory principle to incorporate environmental values into the SNA, while other values, such as unpaid work and leisure time are not included. Second, in the absence of a market, it is difficult to price many environmental values. Finally, monetization of environmental values might misrepresent their true nature -- it may be that some aspects of the environment are not and should not be for sale at any price.

Many of these issues are being addressed in Canada. Environment Canada has established a State of the Environment Reporting office. Statistics Canada has expanded its National Accounts and Environment Division. The Federal government and most provincial governments have established round tables on the environment and the economy. Each of these organizations, together with a host of academics and consultants are grappling with the conceptual issues raised here. Statistics Canada also has undertaken a number of initiatives intended to enhance the information available about unpaid household work in Canada.

One of the most promising initiatives is being undertaken by the Environmental Statistics Section of the National Accounts and Environment Division. This Section prepared 1978, 1986 and 1991 versions of Human Activity and the Environment. The 1991 version contains an analysis of the environmental impacts of economic activity. As many economic activities as possible are classified based on the categories used in the input output tables of the Statistics Canada SNA. These tables

provide information about the commodity transactions involved in each type of economic activities, including the cost of primary inputs, a measure of the value added by sector, and the flow of commodities to end users. This information is used to estimate the total value of inputs and outputs for each industry category - leading to calculation of the GDP. This information also permits estimates of the proportion of inputs constituted by "energy", "raw resource", "potential contaminant", or "other". Estimates are then made about the impact of each input of each category: e.g.. the poultry products industry had $1.5 billion of total inputs, comprised of 56.5% raw resources, 1.2% energy, 0% potential contaminants, and 42.3% "other"; and was rated as high impact in terms of raw resources, but low impact in terms of energy, potential contaminants, and water.

This analysis permits a preliminary categorization and assessment of the different types of industries in Canada in terms of their overall economic importance and in terms of their environmental impact. For example, the report contains tabulations of GDP employment and manufacturing establishment by impact class. The report thus also permits assessment of the degree of economic dependence on energy, resource, contaminant, and water intensive industries.

ii. Despite improved information, decision makers continue to rely on traditional economic indicators

Despite the encouraging developments discussed above, considerably more work is required. The work in Canada is largely confined to Statistics Canada, and has not yet translated into different information demands by central decision makers. This is in contrast to some European countries, where there is some evidence that integrated environmental accounts are actually being used (UNEP-World Bank, 1991).

Little progress has been made toward identifying which decisions need which type of information to ensure that the policy making apparatus as a whole promotes sustainable development. In the meantime - unless conscious effort is made to do ensure otherwise - decision makers will continue to rely on familiar, easily available, but incomplete and, depending on the use, potentially misleading economic information.

b. Recommendations

As the above discussion suggests, Statistics Canada and Environment Canada are devoting considerable effort to resolving the conceptual issues that currently impede the effective integration of environmental and economic information. It is equally important, however, also to improve the institutional mechanisms for presenting what information is available to decision makers.

2.3 Social Indicators

The Ideal

Human well being depends on a wide variety of factors, in addition to physical and economic health. Education, population stabilization, peace, personal security, political freedom, the existence of community support systems and opportunities for individual participation in the political process are also critical components of well being. Sustainable development also requires a focus on equity -- both for future generations, and for the generation now living.

Ideally, information would be available to Canadian government decision makers on this wide range of issues. The information should be aggregated by regions in order to provide information on geographic distributions, and should also reflect trends, in order to provide information on temporal distribution. Finally, wherever possible, the information should be linked to overall measures of well being.

Current Information

Statistics Canada collects and publishes information on labour issues, education, culture, demographics, literacy and justice issues. This information includes reports on the family, on women, on children, on labour force trends, on educational attainment, and on educational costs. Justice and related information at both the provincial and national levels is coordinated through the Canadian Centre for Justice Statistics, a Statistics Canada body.

Statistics Canada also publishes Canadian Social Trends (CST). This quarterly publication provides analyses of various Statistics Canada data and surveys, and includes articles by Statistics Canada personnel and by outside academics. CST also includes a list of "Social Indicators". These include selected population, family, labour force, income, education, health, justice, government expenditures, and economic indicators. In addition, occasionally, CST includes more detailed labour force estimates.

Issues and Recommendations

a. Problems with Current Information

A wide range of information is available to indicate the social status of Canadians. There are two important problems with respect to this information, however. First, there is no agreed upon conceptual framework in which to present and evaluate this information. This problem is even more difficult to resolve than the problems discussed above with respect to health and economics, given that social well being is an even more subjective ideal.

The second problem is that institutional changes are required to improve the use of the wide range of social information currently available. For example, centralized agencies often lack the locally specific information or resources required to deal with many dispersed small scale activities (WRI, 1992). More effort is required to ensure that information is available to support program development at a local level. This may require, for example, that responsibility for planning and executing many social programs should be decentralized.

Institutional changes are also required to ensure that these non-economic aspects of social and human development are accorded equal weight to traditional economic criteria in government decision making. Policy outcomes are largely determined by institutional structures, and in particular by the structures of representation. Institutional design also affects the development of social values. Similarly, the criteria relied upon and the implicit or explicit selection of objectives to achieve and options to weigh in a chosen analytical process - like cost benefit analysis - shape public perceptions of what is at stake.

b. Recommendations

There are no easy solutions to either of the problems identified above. Nonetheless, the Oregon Benchmarks initiative suggests that with suficient leadership, it is possible to identify a set of indicators deemed to reflect social well being. Such an exercise would help focus the future collection of data, as well as focus decision makers attention on the full range of infoiration considered impoertant for public policy.

2.4 Procurement Indicators

The Ideal

A sustainable society would minimize both the use of specific types of energy (non-renewable versus renewable) and materials (environmentally harmful versus environmentally benign) as well as the overall level of energy and material throughput per unit of activity. Achievement of this goal would require information that enables government decision makers to monitor and assess procurement in order to identify opportunities for encouraging the goals of sustainable development through specific procurement actions. In particular, procurement information should identify the origin of goods and services (local community, provincial, Canadian or foreign); the volume and nature of goods and services purchased; the cost effectiveness of the goods and services purchased; and the environmental and social implications of the goods and of the procurement process itself.

Current Information

a. Government Procurement

No comprehensive study of current government procurement has been undertaken since 1983. Supply and Services and its provincial counterparts collect data only on the government procurement for which they are responsible. However, Supply and Services accounts for only about 55% of all federal government procurement (Sourani, personal communication, Jan 27, 1993). The collection of procurement data by other departments is left up to departmental discretion. A number of federal ministries have implemented recycling plans, and have improved their procurement procedures. However, no centralized information is available to permit assessment of these initiatives.

b. Private Sector Procurement

Statistics Canada collects information on household facilities, equipment and expenditures. These data provide some indication of the quantity and value of such items as plastic garbage bags, disposable diapers, heating oil, etc. used by individual households in Canada. In addition, many traditional economic indicators such as GDP, and international trade and price data provide information about the origin and composition (finished good or crude material) of imports and exports. These data can be manipulated in traditional input-output models to provide information about resource and product flows within the economy.

Issues and Recommendations

None of the available procurement data provides an explicit link with environmental or social effects.

Like each of the issues discussed above, procurement information should relate to both macro and micro level decisions. At the micro level the most promising source of information is from product life cycle analysis. The Environmental Choice Programme applies this approach in its certification programme. However, there are many unresolved scientific issues concerning this procedure (U.S. EPA, 1990). These issues must be resolved before a comprehensive analysis of the environmental implications of procurement decisions can be made. The social aspects are even harder to resolve.

At the macro level, there are a number of aggregated indicators that could be developed using available information. For example, total energy and material throughput could be provided by indicators of energy consumption by source - many of which are already available from the National Energy Board. Similarly, indicators of the volume of resources consumed in Canada are available from Statistics Canada. More work is now required to connect this information to related environmental impacts and to specific policy decisions.

2.5 Compliance Indicators

The Ideal

Information is required to monitor and assess the overall effectiveness of and compliance with the policies and laws intended to move Canada along the path of sustainable development.

It is important to recognize the important differences between measures of effectiveness and compliance measures. Compliance information should indicate the degree to which behaviour conforms with regulatory requirements. Effectiveness information should indicate the degree to which policies have achieved their objectives - which may not necessarily occur even with 100 percent compliance under a poorly designed or ill conceived policy.

Issue and Recommendations

a. Compliance Levels

Most government agencies responsible for enforcement activities maintain compliance statistics. In addition, most recent environmental legislation contains self-reporting requirements. However, data are poor for older legislation. For example, Environment Canada does not have adequate information on the extent of compliance with the water pollution provisions of the *Fisheries Act* that have been implemented by the provinces.

As a result of these problems, in 1991 the Auditor General reported that there are "serious weaknesses" in the way federal departments account to Parliament for the results of their efforts to protect the environment. The same complaint can be made about provincial compliance information. No comprehensive statistics exist for the enforcement of many of the wide range of laws and policies administered by all governments directed at protecting or enhancing the quality of the environment, let alone other laws and policies related to non-environmental aspects of sustainable development.

Available data on enforcement activities have a number of problems. First, a range of actions can typically be undertaken with respect to enforcement. Data must therefore distinguish inspections, investigations, warnings, directions, prosecutions and convictions. Second, it is difficult to correlate enforcement actions with compliance levels for three reasons. First, actions taken in a given time period may relate to offenses committed in earlier time periods, and therefore may not provide a good indication of current compliance status. Second, since enforcement can occur for a variety of reasons, simple indication of an enforcement action gives little indication of the seriousness of the violation. And third, the level of enforcement activity may be a better reflection of the level of resources available to enforcers, rather than of overall compliance levels.

b. Measures of Effectiveness

There are two main problems with measures of regulatory effectiveness. First, most regulatory information focusses on government activities. Performance measures are required to assess effectiveness and efficiency. However, the Auditor General repeatedly emphasizes that government has failed to develop adequate performance measures in many areas in which it acts. Consequently, evaluation of government practice often focuses only on procedural compliance. As a result, information is available about enforcement activities from government agencies, but not its results. This problem is partially resolved by the many recent environmental regulations with self-reporting requirements, where information is available about emissions levels. However, this information will not necessarily indicate the nature of change experienced by the target -- whether it is the level of global warming, or the nutritional levels of welfare families.

The second, more fundamental problem is that it is difficult to correlate enforcement actions with environmental or social effects. For example, as the discussion of the information available about the ecosystem suggests, there is a wide range of environmental information available. Much of this information suffers from deficiencies. One of the most important problems is lack of adequate baseline data. This inadequacy undermines most attempts to measure regulatory effectiveness. Thus, even where good compliance data are maintained, it does not necessarily indicate actual environmental consequences. For example, Environment Canada's 1988 Report to the International Joint Commission failed to show what progress had been made toward eliminating toxic substances from the Great Lakes.

3. THE ECOLOGICAL SUBSYSTEM

There is more information now available about Canada's environment than ever before. Unfortunately, information often exists for some parts of the country, or for some components of the environment, and not others; data exist for limited periods of time, thereby precluding analysis of environmental trends; and regional data cannot be compared because measurements are not standardised (Environment Canada, 1991).

3.1 The Ideal

The 1992 publication Caring for the Earth: A Strategy for Sustainable Living (IUCN et al. 1992), describes scientific knowledge, and public understanding of its implications, as the foundation for well formulated and widely supported policies for sustainability. Toward this end, national and provincial governments are encouraged to "establish monitoring systems and information databases that provide continuous, long-term series data on key physical, chemical and biological features of the environment." They should also monitor the performance of policies, laws and other institutional arrangements, track the progress of environmental protection measures against stated benchmarks, monitor land-use changes, and chart changes in public behaviours and attitudes. Finally, a program of "national environmental auditing should be established, with governments reporting on a regular basis on the state of their environment" (IUCN 1992, p.75).

The IUCN has described the overall objectives of information collection, but has not provided sufficient guidance on what specific information should be collected or how these data should be analyzed. According to Holtz (1992), decision makers need two general forms of environmental information: 1) in-depth environmental reporting; and 2) system-oriented, overview reporting that describes overall environmental change. In-depth data consist largely of fine-grained observations describing a narrowly defined portion of the ecosystem in detail. In contrast, overview reporting takes a step back from the detailed observations of individual ecosystem components to describe how these different components come together to form ecosystems.

Overview information is essential if decision markers are to make coherent and effective policy decisions on sustainability. This information provides a broad understanding of ecological and human sub-systems necessary to evaluate the potential implications of various policy options and to select those options that best achieve sustainability. At this level of decision making, detail is sacrificed in order to understand the broader implications of a particular policy direction. Detailed information is important not only as support for the overview reporting, but also to guide the detailed implementation of policy decisions since sustainability requires both sustainable policies and sustainable implementation.

Each individual scientific discipline has developed its own extensive and comprehensive information base. However, what is missing in support of sustainability reporting is greater direction on what specific environmental information should be collected for its own unique purposes. Preliminary criteria for this selection have been developed by Environment Canada as

part of its National Environmental Indicators Project (SOER 1991). To be considered an appropriate environmental indicator, a measure should:

- be scientifically valid
- be supported by sufficient data to show trends over time;
- be responsive to changes in the environment;
- be representative;
- be understandable;
- be relevant to stated goals, objectives and issues of concern; and
- have a target or threshold level against which to compare it.

Indicators provide a convenient means to assess the status of certain environmental conditions and overall environmental health, but indicators alone will not provide enough information to understand how systems respond to anthropogenic stress and to evaluate management policy options designed to deal with the causes of this stress. This requires information that more clearly defines linkages between the in-depth research and overview reporting. Such linkages may not be well defined by an information base consisting only of discrete databases. Instead, what is needed are collections of databases containing compatible information that can be linked in organized fashion.

For example, if a decision maker is concerned with the sustainable utilization of northern cod, an estimate of current population size is important, but decision makers also need to know how the northern cod population might respond to different levels of fishing intensity. This requires access to data on many components of the marine ecosystem, including information on species that support cod as a food source, data on species that prey on cod, availability of suitable cod habitat and information on marine chemistry that might affect the ability of the cod to reproduce and thrive.

Unfortunately mechanisms and procedures to combine and integrate information across disciplines are poorly defined, and efforts to achieve integration exist largely outside the traditional information loops present within disciplines. This prevents two levels of information integration that are crucial for sustainability reporting. First level integration refers to the pooling of similar or mutually compatible data from different disciplines (i.e., water quality data from the biological, geological and chemical sciences). Pooling of similar information increases the utility of the data that are collected since trend, patterns, correlations and inconsistencies often become clearer as the sample size increases. Therefore, one of the easiest and most cost-effective way to improve the quality of a database is to combine it with another similar database. The result is better information on which to conduct in-depth research which will in turn support overview reporting.

Second-level integration involves the combination of data from individual system components to create a more complete picture of individual systems or the global ecosystem as a whole. As with first-level integration, this also involves bringing information together, but in second-level integration, the links are made between different rather than similar aspects of the ecosystem in order to gain a more complete understanding of the entire system. For this type of integration to occur, the data within each database must be collected using methodologies that make integration between databases possible. In addition, the database structure must be compatible to allow access using standardized criteria such as geographic location or a universal reference number.

Few databases have been created with integration in mind. They usually meet the needs of the in-depth research they were originally set-up to support, but are often incompatible with other databases set-up for different purposes. Incompatibility arises from factors such as problem definition (agencies sometimes use different set of parameters to define the same problem), data collection (sample location, timing, sampling techniques do not coincide) and database structure (organized according to station number rather than geographic location). This can lead to a situation

where databases describing different components of a single ecosystem cannot be brought together to investigate the system as a whole.

Under the ideal situation, data incompatibilities should be minimized. This objective can best be reached by taking a strategic approach to data collection and management. Together, all levels of government should define their own information needs and identify areas where either pooling or integration would contribute to the achievement of those needs. Responsibility for data collection would then be assigned and standardized methodologies and database structures would be defined to accommodate efficient information sharing.

Conceptually, there needs to be a continuing shift:

- from information on specific elements of the environment to information on ecosystems, the scientific establishment of causal relations, and the improvement of prediction and warning capacities, all of which would cover the full spectrum of environmental relationships within any given region;

- from reacting to environmental problems as they arise to anticipating and preventing them in advance; and

- from a focus on environmental impact to an emphasis on addressing environmental problems in the context of sustainable economic development. (Environmental Information Statement, 1991)

In summary, the ideal objectives for information collection and management in support of sustainability reporting would be:

- to provide continuous, long-term series data on key physical, chemical and biological features of the environment;
- to monitor the performance of policies, laws and other institutional arrangements;
- to monitor the progress of environmental protection measures against stated benchmarks;
- to monitor land-use changes;
- to monitor changes in public behaviours and attitudes; and
- to report on a regular basis on the state of the national or provincial environment.

Specific information parameters would:

- be scientifically valid
- be supported by sufficient data to show trends over time;
- be responsive to changes in the environment;
- be representative;
- be understandable;
- be relevant to stated goals, objectives and issues of concern; and
- have a target or threshold level against which to compare them.

Analysis of this information should occur at two general levels:

- in-depth, issue-oriented analysis; and
- system-oriented, overview analysis that describes overall environmental change.

Databases in support of this analysis should:

- allow for the pooling or linking of similar data or data that are mutually reinforcing;

- allow for the linking or integration of databases that contribute to the comprehensive description of entire systems or the global ecosystem

Finally, information collection should take place within an overall information collection and management strategy that achieves all of this in an efficient and effective manner.

3.2 Current Information

The federal and provincial governments collect vast quantities of data and information on many aspects of the ecosystem. For the most part, these data are collected in support of either research for publication in academic journals, monitoring for resource management or monitoring for compliance with regulations or guidelines. The research most often takes place largely within highly specialized scientific disciplines or sub-disciplines within the biological, physical or chemical sciences and the contents of these databases often reflect this high level of specialization. In their current form, the data are often too technical or too detailed to be of value to most decision-makers to support sustainability decisions. Monitoring data are often less technical and more directly relevant to sustainability issues, but they usually focus on a narrow set of parameters and provide only a partial description of the ecosystem as a whole. Since the data were collected to support the specific needs of researchers and regulators, it is not surprising that the current information base does not adequately serve the needs of decision makers.

The next section examines further the adequacy of the current information base through a closer examination of the individual databases and compares them against decision-maker needs. This examination is followed by a discussion of the federal government efforts to present the current information base in a form that is more amenable to sustainability decision making.

3.2.1 Evaluation of the Existing Information Base

Governments collect environmental data for a wide range of reasons. Some databases are assembled to examine specific questions such as the number of waterfowl nesting colonies on a particular stretch of coastline. Others are intended to cover broad topics such as the productivity of the forestry sector or the quality of the air that we breathe. In this section, we are primarily interested in how this information can be used by government decision makers when evaluating options and taking action to promote more sustainable forms of development.

Holtz (1991) describes the information requirements for each stage of the decision-making process, from problem definition through to action, feedback and monitoring. We apply these information requirements below as criteria to categorize the environmental databases which the federal government uses. Environmental information to support government decision-making falls into four categories:

Category 1: Research data used to define a process or condition, or to address a particular hypothesis.

Category 2: Monitoring data, usually collected to determine long term trends, compare against guidelines or to track the status of a particular resource.

Category 3: Surveillance data collected to enforce regulations for compliance or for legal actions.

Category 4: Composite datasets that link data from several disciplines to provide an overview of ecosystem relationships.

Data in each category are collected to meet different objectives, and the form that the data take will differ depending upon the needs of those who use the databases most often. For category 1, the scope of possible research needs is broad and the data could take almost any form from descriptive text, quantitative observations, maps or even photographs. Category 2 and 3 data most likely take the form of quantitative observations focussing on a standard set of parameters collected on a recurring basis. Category 4 databases often contain a number of different datasets brought together to facilitate integrative analysis at a systems level. Note that the first three categories correspond roughly to Holtz' (1992) in-depth environmental reporting, while category 4 contributes more directly to overview reporting.

Our evaluation of information on the ecological subsystem focuses primarily on databases listed in the publication entitled Databases for Environmental Analysis: Government of Canada (Environment Canada and Statistics Canada 1992). This inventory of "federally held databases of potential use in environmental reporting" has been compiled jointly by the National Accounts and Environment Division of Statistics Canada and the State of the Environment Reporting organization of Environment Canada. We first divided the databases listed in this publication according to ecological system: atmospheric, aquatic and terrestrial. We then grouped databases within each ecological system according to the four decision-making categories described above. Once organized in this matter, we evaluated the information within each system against the ideal situation described in Section 3.1 above. It should be noted that we had to apply our professional judgement in assigning a few of these databases to these categories but we feel that these few cases do not detract from the overall conclusions of the evaluation.

Atmospheric system

Atmospheric Databases			
Category	DOE	EMR	AgCan
1	3	2	0
2	13	1	1
3	5	0	0
4	0	0	0

Description

Environment Canada is the main federal department currently collecting data on air. Agriculture Canada has one database monitoring meteorological information in agriculturally relevant locations, and EMR possesses macrofossil and paleoclimate data that are useful in historical climate modelling. The information collected in category 1 is primarily meteorologic atmospheric chemistry data and includes parameters such as temperature, wind speed, precipitation amounts, and air and rain chemistry. Thirteen out of Environment Canada's 21 air databases monitor either for acid precipitation or ambient air quality, sampling for a list of standard pollutants such as SO_2, NO_X, CO, total hydrocarbons and particulate matter. Most of these monitoring databases are national in scope, and in several cases provincial data are included in the database.

Evaluation

These databases provide long term series data on key physical and chemical parameters of the atmospheric environment. They contribute to the monitoring of performance of air quality regulations and the progress of environmental protection measures. The selected information

parameters are scientifically valid, show trends over time and are responsive to changes in the environment. They also have targets against which to compare them. Within government, analysis of the data is largely in connection with in-depth research and monitoring. As such there are no category 4 databases. However, the data in the other categories are in a standardized form such that both pooling and integration is possible by outside users, and they are easily incorporated into research leading toward overview environmental reporting. This shows that it is not necessary that governments maintain integrated databases themselves, as long as the databases that they do maintain are structured to facilitate easy linkage and integration.

Overall, the adequacy, availability and accessibility of air quality and meteorological data at the national level appears to be good. Most databases are national in scope and cover a standard set of parameters using methodologies that are well documented. In particular, three databases appear to make up the national network. The National Air Pollution Surveillance Network (NAPS) contains data on air quality from 140 monitoring stations located in 55 cities across Canada. The focus is on urban air quality and compliance with national abjectives established in the Canadian Environmental Protection Act. The Canadian Air and Precipitation Monitoring Network (CAPMON) and the National Atmospheric Chemistry database (NATCHEM) both contain data on long range transport pollutants with relevance to acid precipitation. Monitoring locations for both are concentrated in the rural areas with CAPMON data coming from federal stations only while NATCHEM includes data from federal and provincial stations. Negotiations are currently underway to add some U.S. stations to the NATCHEM network.

From the standpoing of sustainability, the utility of these databases is high because they have been designed to meet the issue-based needs of a broad user group. The purpose of the two acid precipitation databases are intended to serve researchers investigating long-range transport of pollutants. In particular, NATCHEM was designed in close cooperation with provincial and U.S. atmospheric scientists to ensure that parameters, methodologies and database structure were consistent in all jurisdictions. This allows for easy information sharing and data manipulation. Similarly, the decision by NAPS database managers to retain a consistent set of parameters and sampling locations has resulted in a long-term dataset capable of tracking trends in air quality over time and space.

Unfortunately, maintaining a consistent, long-term dataset is a double-edged sword because the air quality parameters considered most important ten years ago may not be the ones needed to solve issues today or into the future. Data on volatile organic substances (VOCs) and other airborne persistent toxins have been identified by scientist as a significant air quality concern, but very little comprehensive data are available on these parameters. Given the high cost associated with sampling for these toxic chemicals, database managers are faced with a dilemma: to maintain the long-term dataset or sacrifice part of it in return for additional toxic parameters. The Atmospheric Environment Service (AES) of Environment Canada is considering the addition of some toxics to thier NATCHEM network, thus taking advantage of the infrastructure and links to researchers that already exist. In addition, the Conservation and Protection Service of Environment Canada is considering expending its NAPS parameter list to include some toxics and is also planning to add some non-urban data to account for the long-range transport of urban smog. Although the potential exists for overlap, this is lessened by the fact that both databases are held on AES computers, and communications between the two groups on this issue appears to be good (Vet 1993).

To summarize, from the standpoint of sustainability reporting the current information base is both useful and accessible, meeting many of the criteria of the ideal system. This is largely because the data have been collected and stored with the needs of the end user in mind. In addition, atmospheric data collection has focussed on a standard set of parameters that have been used as indicators of issue-specific or overall atmospheric conditions. Although it helps that at the federal level the information is collected and managed almost exclusively within a single department, the

success of the information base is enhanced greatly by the participation of the provinces. The data services a broad range of users who require atmospheric data as input to other research or analytical activities. The information has served their purpose well to date, but there appears to be a growing need for information on additional air quality parameters. Selection will require consultations with users to determine which parameters can best meet current and future research and decision making needs. In this way, the information base can provide the maximum utility for the resources.

Aquatic System

Aquatic Databases					
Category	DOE	DFO	EMR	DIAND	AgCan
1	2	17	1	0	0
2	22	61	0	8	0
3	13	6	0	1	0
4	2	11	0	0	0

Data on the aquatic ecosystem are found in Environment Canada (DOE), the Department of Fisheries and Oceans (DFO), and to a lesser extent the Department of Indian and Northern Affairs (DIAND). In general terms, DOE data are limited to freshwater quality and quantity, DFO focuses on marine water chemistry and marine biota, and DIAND has information on freshwater quality in the north.

More specifically, DOE's freshwater data focus exclusively on surface (and to a lesser extent groundwater) quality, quantity and snow/ice conditions. Parameters cover a standard range of physical, chemical and biological properties with the major difference between databases being geographic location. National data from over 10,000 stations are complied in the National Water Quality Database (NAQUADAT). Although this database contains a vast amount of data from federal and provincial sources, the coverage is inconsisent both geographically and substantively. For example, a great deal of information has been obtained from the Quebec provincial government, but almost nothing has been received from Ontario. Also, no national direction has been set regarding the parameters that are selected or the manner in which samples are collected, analysed or recorded (Brooksbank 1993). In addition to this national database, DOE maintains a number of regional, local or single issue databases describing things such as Great Lakes water quality, water quality in the vicinity of an industrial discharge or water chemistry as it pertains to shellfish harvesting.

Although the vast majority of DOE's databases fall into categories 2 and 3, it does maintain two category 4 databases that deserve particular note. The Atlantic Region maintains a GIS database that combines surface water quality data and loadings data on GIS generated maps. Also in the Atlantic Region, The Fundy, Gulf of Maine, Georges Bank Resource and Environmental Database is an integrated digital database of maps, numerical data and text files for physical, ecological and socio-economic information for the Bay of Fundy, Gulf of Maine and Georges Bank region. This provides a useful tool for bringing together information from various disciplines in one place, making it possible to identify linkages that might otherwise go unnoticed if data were discretely managed. It is also DOE's only aquatic database that includes any information on aquatic biota.

In contrast to DOE's focus on water quality and quantity, DFO appears to have taken a systems-approach to data collection by including information on all aspects of the marine aquatic

environment from water chemistry through to marine mammals. Physical databases in categories 1 and 2 contain information on ocean chemistry, temperature, salinity, tides, currents and waves as well as some physical and chemical information on stream and rivers used by anadromous fish for spawning. Biotic databases examine all trophic levels from plankton through to killer whales and sea lions. Parameters within these databases include population abundance, distribution, habitat (where applicable) and general biological information. In some cases, these biotic database contain references to other research that has been conducted on the topic area. DFO databases also contain information on fisheries activities such as fish plant production, licenses, equipment/gear surveys (cost and use). It is instructive to note that two of the regions have databases that integrate marine biological and oceanographic information.

DFO's category 2 databases focus more closely on the department's mandate of fisheries management. They include data on catch (quantity, and location), fishing effort and the type of gear used. Although data are collected and analyzed regionally, parameters appear to be standardized to allow for aggregation between regions and annual reports are generally provided. Category 3 databases contain information on permits and licenses.

DFO maintains a relatively large number of category 4 databases that take an ecosystemic approach to data collection and management. Within a single database, data are compiled on the physical, chemical and biotic components of the aquatic ecosystem. The geographic scope ranges from a collection of lakes and rivers to the near-shore and tidal areas of the Gulf of St. Lawrence.

DIAND maintains databases on ground and surface water quality in the North. Information is collected largely to assist in making water quality guidelines and assessing compliance. Groundwater data are compiled to assist in exploration and management of the resource.

Evaluation

In support of its mandate to manage fish stocks, DFO has collected data from each major component of the marine aquatic ecosystem. Although the geographic coverage under some components is patchy (ie. marine mammals from Pacific and Arctic but not Atlantic), a comprehensive information base is beginning to emerge within the department, at least in marine aquatic systems. Long term series data exist for some key physical, chemical and biological features of the environment, and from the standpoint of fisheries management, the focus has been to monitor the performance of policies and the progress of resource management measures. However, recent experience estimating the size and long-term viability of northern cod stocks demonstrates the limitations of the current information base to manage fish stocks sustainably. Not only must scientists estimate the population and age structure of fish schools using indirect observations and measures (ie they cannot physically dive down and count them, but must rely on catch and effort statistics), but they must also understand the vast and complex marine system that supports the fish. Additional work, some of it already under way, is clearly needed to define adequate indicators for the marine environment.

Although DFO's databases span a broad range of ecosystem components and trophic levels, integration and links between these databases have not yet been achieved (Sly 1993). The illusion of an ecosystem approach has been created because the mandate for the entire marine ecosystem is contained in one department, but the data are not managed in a way that facilitates ecosystemic analysis. Class 1 research databases are created to serve the needs of researchers who study and publish in specialised scientific fields. As a result, little or no consideration has been given to standardizing sampling locations, parameters, collection methodologies or database structure between specialty fields such that information collected in support of zooplankton research can also be used to support research into fish or marine mammal population dynamics (Bodaly 1993). Similarly, monitoring data in Category 2 are collected to support specific regulatory and monitoring functions. Although much of this monitoring data is used in support of resource management

research and investigation, much additional utility in terms of ecosystem understanding is not taken advantage of.

The department has created five integrated marine databases that bring data from several of these components (ie water quality, plankton, fish and marine mammal data) together within a single database. This makes cross referencing data from different components within the system (ie cod and sea lions) easier and more accurate. However, it is questionable whether large, integrated multi-disciplinary mega-databases represent the most effective direction in which to proceed. The effort required to create these databases can be considerable. Also, depending upon the characteristics of the data and the way the database is structured, the resultant database may not be flexible enough to meet the diverse and changing demands of resource managers and decision makers. Efforts could be better spent facilitating the linkage existing databases and collecting data that are better equiped to meet future needs.

The situation with information on freshwater aquatic systems is further complicated by the division of responsibilities between DOE, DFO and the provinces. Between them, DOE and the provinces provide a reasonably comprehensive, nation-wide picture of water quality and water quantity data. However, the utility of this information has suffered from a lack of overall coordination, standardisation and direction. As discussed above, the NAQUADAT database contains a great deal of information, but decisions regarding what to include in the database, how the data are collected and for what purpose are made by individual regions or provinces. As a result, NAQUADAT appears to be more of a repository for Canadian water information rather than a description of freshwater quality and quantity in Canada.

Similar problems exist at the provincial level. In a recent examination of Ontario's Aquatic Environment conducted by the Rawson Academy of Aquatic Science for the Ontario Ministry of the Environment, data from federal and provincial databases were found to be incompatible. Sample parameters, sampling locations, sampling techniques and even the definition of watersheds between databases were inconsistent, making integration and aggregation very difficult to achieve. It is instructive to note that these inconsistencies also existed to a similar degree at the provincial level between ministries and was even broadly evident within ministries.

Terrestrial System

Terrestrial Databases					
Category	DOE	Foresty	DIAND	AgCan	EMR
1	19	0	0	4	10
2	25	13	8	6	4
3	4	0	6	0	0
4	1	1	2	0	0

Description

Databases on terrestrial ecosystems are found in Environment Canada (DOE) Forestry Canada, Indian and Northern Development (DIAND), Agriculture Canada (DA) and Energy Mines and Resources (EMR). At a general level, databases maintained by DOE focus on land use, habitat protection and migratory birds. Forestry Canada collects information on forestry resources and forest pests, DIAND monitors land use and resource utilization in the north, DA maps the agricultural potential of soils and EMR collects geological and mineral data.

32 of DOE's 49 terrestrial databases contain information on migratory birds. The other databases cover: 1) land use issues such as habitat protection, conservation areas and parks; 2) wildlife issues such as endangered species or pubic opinion on the importance of wildlife; and 3) contaminant levels in wildlife tissue. The most useful of DOE's land databases from the standpoint of sustainablility reporting is the Canadian Geographic Information System which contains the Canada Land Inventory. According to the Databases for Environmental Analysis, this national GIS database includes data for agriculture, forestry, recreation, wildlife and land use along with other administrative layers including census divisions, watersheds and ecological land units. However, the majority of the data reflect land compatability information based on Canada Land Inventory classification rather than more specific information on land use and habitat type.

In other departments, Foresty Canada's databases contribute information on the status of the forest resource and data on the impact of pests, fire, disease and acid rain to that resource base. Much of this information is aggregated Agriculture Canada maintains five descriptive databases that examine land and soil potential. Parameters include soil characteristics, constraints, productive capacity and susceptibility to degradation. Their sixth database contains information on plant pests. Finally, EMR nine databases cover a range of technical information including permafrost distribution, earthquake records, general geotechnical surveys and mineral deposit size and location.

Evaluation

The Canada Geographic Information System provides a good, national description of Canada's physical land base, land capability and land use. As a GIS information base, it would provide a good foundation for more detailed work on the terrestrial system. Unfortunately, this more detailed work appears to be absent. According to The State of Canada's Environment - 1991 (Environment Canada 1991), our knowledge of the land base is inadequate at every level - national, provincial, regional and local -- and no one jurisdiction of department has taken a leadership role to remedy this situation.

Comparing the information base to the ideal situation, long-term series data are patchy, and the overall coverage of terrestrial ecosystem components is partial at best. Vegetation data are limited to trees and agricultural crops, both of which are viewed in relative isolation from the rest of the terrestrial ecosystem. Land use changes have been monitored in some regions of the country, but again the overall picture is incomplete. Information is likely to exist at the provincial level where jurisdiction over the terrestrial ecosystem largely resides, but little evidence of a national compilation of any of this information can be found in this review of federal databases.

The information base for the terrestrial ecosystem is poor at the federal level. Little evidence of information sharing either among departments or between levels of government could be found in databases. The large number of departments, agencies and levels of government with jurisdiction in this area has resulted in a highly fragmented and patchy picture of the terrestrial ecosystem in this country. Pooling or linking existing databases would be the first step in constructing a more complete picture, but with so many agencies involved in collecting and managing the data, the likelihood of finding a great deal of compatible data is remote.

3.2.2 Publications in Support of Sustainability Reporting

In 1986, Environment Canada published the first national State of the Environment Report. The stress-response model provided the conceptual foundation for this pioneering effort. Factors of environmental stress such as pollution loadings, land use changes and resource exploitation were categorised and ecosystem responses (e.g., changes in productivity or species composition) analysed in the context of 19 terrestrial and marine ecozones defining broad ecosystem boundaries.

The second report, published in 1992, is a much more ambitious effort aimed at addressing four main questions: 1) What is happening in Canada's environment? 2) Why is it happening? Why is it significant? and 4) What are Canadians doing about it? Toward this end, the report refers to some of the data described in section 3.2.1, along with a variety of other published and unpublished reports on aspects of the Canadian ecosystem, to produce a comprehensive picture of Canada's environment. To the extent that the data are available, much of the information is presented to demonstrate the link between the environment and human activities. Further integration is shown in regional case studies described in Part III of the report and under "Current Issues" discussed in Part IV.

In its latest National SOE report, Environment Canada has gone a long way toward achieving its objective "not only to describe environmental issues in a Canadian context, but also to provide non-specialist readers with a user-friendly guide to significant environmental trends and human activities, and current Canadian responses to environmental deterioration" (Environment Canada 1992). Although the approach used in the second report differs significantly from that of the first, making it difficult to discuss trends over the six-year interval, the second report presents a more complete picture of the Canadian environment.

Environmental indicators and issue-specific background papers are currently being developed to address the particular needs of decision makers by presenting information in a more concise, less detailed manner. In 1991, Environment Canada published *A Report on Canada's Progress towards a National Set of Environmental Indicators* and continues to publish a series of background papers on environmental reporting. Other agencies publish reports which also have environmental information. Every year, Forestry Canada publishes *The State of Canada's Forests*, comprising environmental, economic and social indicators. The Department of Fisheries and Oceans, Agriculture Canada, the Department of Energy, Mines and Resources and other government agencies (e.g., the Atmospheric Environment Service and the Ecosystem Science and Evaluation Directorate, both of Environment Canada) also publish periodic reports on various aspects of Canada's environment.

Statistics Canada publishes *Environmental Perspectives 1993, Human Activities and the Environment, Households and the Environment.* In partnership with *Environment Canada, Statistics Canada* also publishes Databases for Environmental Analysis - Government of Canada. In addition, the agency provides a customised Environmental Information System service which can link a wide variety of social and economic data series commonly used in the analysis of environmental issues to a variety of geographic units. These represent the federal governments most sophisticated efforts at linking and analysing environmental, economic and social data together to investigate correlations and possible cause-effect relationships. These efforts have been discussed in greater detail in Section 2.

3.3 Summary and Conclusions on Ecosystem Reporting

The databases reviewed above meet the information requirements they were designed to fulfil. Unfortunately, few can be integrated.Only 17 of the 272 databases reviewed incorporate the ecosystem perspective necessary for sustainability reporting by including data from different disciplines. None incorporates a broader perspective that might include data from different systems (ie. atmospheric and aquatic data).

All other databases have been designed to meet specific research, resource monitoring or surveillance monitoring needs. Of these, research databases (category 1) and surveillance monitoring (category 3) databases are often the most detailed and focussed. Resource monitoring data can be valuable to decision-makers and environmental managers if the focus of the monitoring

matches current needs. Unfortunately, it is difficult for decision makers and managers to identify those situations where such a match exists. This deficiency is being addressed by the publication of reports such as the *Databases for Environmental Analysis: Government of Canada* (Statistics Canada and Environment Canada 1992) and by Statistics Canada's Environmental Information System, but it will take time before these tools become incorporated into the decision-makers' standard information search strategy.

The point is not that all environmenal and natural resource databases be integrated but rather that they be capable of integration by using consistent parameters. Achieving methodological consistency represents a challenge in itself. It is one compounded by significant institutional barriers resulting the administrative organization of government both at the federal and provincial levels. The 1987 report of the stakeholder group on environmental reporting noted the following barriers to environmental information in Canada:

- no comprehensive network of information sources;

- no comprehensive framework describing the scope or extent of interactions between human actions and the environment;

- little knowledge of, and often no means of obtaining, data collected by industry, hospitals, universities and research institutions for their own specific purposes;

- insufficient data to permit understanding of linkages between economic activity and resource activity or to permit effective risk analysis or epidemiological studies;

- no independent institution or agency capable of assembling environmental data and assisting in interpretation;

- inadequate ongoing national monitoring program to determine levels of toxic substances in human, fish and wildlife populations;

- significant regional variations in the availability of data. (Stakeholder Group, 1987)

4. HUMAN-ECOSYSTEM INTERFACE

4.1. Energy

Society's choices about the amount of energy it needs, the types of energy it harnesses to meet these needs and the degree of pollution control it practices in harnessing these resources, largely determine the quantity of energy-related wastes released into the environment and therefore the environmental impact of energy use. In the words of the World Commission on Environment and Development, "choosing an energy strategy inevitably means choosing an environmental strategy" (WCED, 1987).

The development of Canadian energy resources has imposed significant environmental costs as well as contributed to economic growth. In a modern industrial society, such as Canada, this fact poses a major dilemma for policy-makers: on the one hand, energy development, both for domestic and export use, makes a substantial contribution to the material welfare of Canadians; on the other, the continuation of current trends is environmentally unsustainable and, thus threatens the very lifestyle our energy use has made possible in the first place.

The Ideal

Marbek Resource Consultants Ltd. (1990) has developed a family of four indicators to measure the environmental and economic sustainability of energy production and use. These indicators would measure the quantity of energy produced and used; the environmental impact per unit of energy production or use; long term resource availability; and the energy productivity of the economy.

Current Information

Most of the information available to energy policy-makers at the federal and provincial levels concerns the first indicator above on energy production and use. Such information is collected and analysed by several agencies, including Statistics Canada, the National Energy Board, the Department of Energy, Mines and Resources and various provincial ministries. On the production side, it is available in both highly disaggregated and aggregated forms by source and point of production.

On the consumption side, energy statistics are typically presented by sector of economic activity (e.g., industrial, commercial, residential, transport). As policy-makers try to reduce the environmental impact of energy use by matching source to use more appropriately, it has become apparent that current statistics do not reveal all the information required (e.g., aggregate requirements for different degrees of heat).

Measuring environmental impact per energy used, Marbek's second indicator, presents complex methodological problems. It is very difficult to quantify the environmental costs of energy use because many of these costs, such as the loss of wildlife habitat are impossible to estimate in economic terms. In other cases, the impacts themselves, such as climatic change, are not well understood. Finally, no methodology exists to compare risks as diverse as airborne pollutants, marine oil spills and exposure to radioactivity. As a result, the information collected on the environmental impacts of energy use tends to be disaggregated by source. The 1991 State of the Environment Report provides a good example of the state of the art in this regard. With minor exceptions, the environmental costs of energy use are not reflected in the prices Canadian consumers pay.

Measuring long term resource availability raises obvious uncertainties related to geological knowledge, in the case of non-renewable fuels, technological progress and fluctuations in price. Nevertheless, considerable information exists both nationally and regionally on all conventional energy sources. Less is known about the potential contribution of non-conventional sources where production is often small-scale, production history is short and where technological innovation and price trends cconstitute the main determinants of future supply.

Since the first oil price shock in the early 1970's, policy-makers have become aware of the importance of measuring the energy productivity of the economy (also referred to as energy intensity), in other words, the amount of energy consumed to produce a dollar of GNP. Canada is one of the most energy-intensive countries in the world. The reasons include: a cold climate; the size of the country; and industrial structure. The production of primary commodities (e.g., pulp and paper, minerals, agricultural goods) which accounts for a significant part of the Canadian economy, is energy-intensive. The countries which import our raw materials benefit from Canada's energy-intensive activity by avoiding many of the associated environmental impacts.

Canada's energy intensity has declined appreciably since the early 1970's but not as much as that of most of its major trading partners. The domestic potential for further energy efficiency gains is believed to remain very large although experts disagree about its precise scope. These disagreements arise both out of methodological differences and differences about the proper role of government in energy policy. In a market-oriented energy policy such as the current one, the government has little need for energy intensity indicators since it limits its interventions to few

cases, such as market failures. As a result, the information available to governments on energy intensity plays a minor role in Canadian energy policy.

4.2. The 3 R's and Composting

The Ideal

Canadians are among the largest producers of garbage in the world (SOE, 1991). Garbage creates obvious environmental problems, whether stored in landfills, incinerated, deposited in water, or illegally discarded by the roadside or dumped in waterways. The "NIMBY" problems concerning the siting of landfills and incineration plants exemplify the considerable social problems created by waste disposal. In addition, current waste disposal practices are at least in part responsible for the current disregard for waste on the part of most producers and consumers. As a result, current waste management practices are implicated in the overuse of materials and energy and the unnecessary depletion of ecosystems.

Ideally, governments should have access to sufficient information about waste management to allow them to put in place policies and programs to reduce both the total amount of waste and the harmful effects of waste. This would require regional information about the content and source of waste, on an aggregated basis, per capita, and per unit of GDP (IUCN et al, 1990). This would also require information on existing waste management practices, including the availability of recycling programs and the extent to which user cost requirements are in place and enforced. Information should also be available about the environmental and social effects of waste. Finally, information should be available about initiatives and opportunities to reduce, reuse, recycle and minimize the effect of waste.

Current Information

Responsibility for waste management is shared among all levels of government. Consequently, there is very little aggregated national information. Moreover, the quality of available data varies between jurisdictions and issues. The Office of Waste Management (OWM) at Environment Canada maintains some data. Transport Canada oversees the Transportation of Dangerous Goods Act, under which other data is collected. At the provincial level, the Ontario government has a fairly well developed information system, which includes both the Office of Waste Reduction within the Ministry of the Environment and the Recycling Council of Ontario (RCO). The RCO provides information to both governments and private citizens on specific issues, on new waste management techniques, and can provide aggregated data by municipality and province-wide on waste disposal and recycling practices.

Much of the information on waste has been generated by consultants or government enquiries, focusing on specific issues. Most of the best data concerns municipal solid waste. Most provincial governments set standards for solid waste disposal, and provide a regulatory function, while the municipalities are responsible for collection and disposal. Consequently, reasonably good information is available on the quantity, composition, and source of much municipal waste. However, there is little information available about the environmental effects of municipal - or any other waste.

The Canadian Council of Environment Ministers has taken an active role in waste management issues. The CCME has sponsored a number of studies and has established a number of guidelines, including incinerator stack emissions and the National Packaging Protocol (NPP). The National Packaging Monitoring System was established in 1991 under the NPP. Surveys conducted under this system have helped Statistics Canada and the OWM prepare a database designed to help monitor packaging reduction targets (Household Environment Surveys).

Issues and Recommendations

According to the 1991 SOE report, the paucity of data on waste is a symptom of the "out of sight, out of mind" attitude toward waste management in Canada (SOE, 1991: p. 25-18). With the exception of Ontario and Alberta, data are unavailable on quantities of waste produced and methods used to manage it. Government procedures for controlling and tracking hazardous waste are also inadequate. For example, the Commission D'Enquête Sur les Déchets Dangereux (1990) was unable to account for nearly one-third of the wastes sent off site for treatment in the province of Quebec.

One of the problems with collecting aggregated waste information is that much information is only useful on a local basis. In particular, waste composition studies are primarily useful at a local level. While in theory it should be possible to aggregate from local studies, that is not yet possible because local studies are incomplete and do not share uniform scientific focuses.

A number of recent initiatives indicate that governments are starting to address these problems. Statistics Canada recently conducted a Municipal Waste Management Survey (****). The National Task Force on Packaging initiative has also generated some useful data. Similarly, the Recycling Council of Ontario is proving to be an effective clearing house for waste management information. In addition, some recent legislation attempts to facilitate recycling. For example, the Export/Import regulations developed under the Transportation of Dangerous Goods Act provide alternative controls for hazardous wastes destined for recycling operations. And at the provincial level the Ontario government has recently passed the ambitious Solid Waste Management Act. Regulations being developed under the act will require, among other things, that targeted industries maintain waste inventories on premises.

4.3 Conservation Actions

The Ideal

Sustainable development requires maintenance of our natural, social and cultural heritage. Sustainable development thus requires that efforts be taken to minimize the environmental, social and cultural damage of our activities. In addition, the principle also requires that we restore past damage, and that where future damage is unavoidable, some action be taken to offset that damage. In this regard, the Brundtland Report described protected areas as an indispensable prerequisite for sustainable development, and called on all nations to complete a network of protected areas to conserve representative samples of Earth's species, ecosystems and cultural heritage.

Efforts to protect Canada's biological and cultural diversity require high levels of both understanding and general awareness of the current status and future trends of our natural and cultural endowments. Ideally, this would entail the systematic collection of data on the extent and trends in the loss of existing endowments; classification of that data in terms of endangered, threatened or extirpated; an understanding of what factors are causing the loss; and an understanding of what factors are required to provide adequate protection in the future.

Although important, the latter requirement has been overlooked. Policy makers have only recently come to understand that protection cannot be ensured simply be designating an area as a park or as a heritage site. Although parks and ecological reserves provide some protection for wildlife and for natural ecosystems, they are not, by themselves, adequate. Protected area are subject to the effects of human overuse, acidic deposition, and air and water pollution from outside their borders. Moreover, most protected areas are too small to protect the full range of plant and animal species they originally contained. The problem with respect to historic or cultural sites may be even more difficult since the basic objective is to preserve in an unchanged state, rather than to ensure ongoing

vitality. Information about what factors are required to provide adequate protection in the future is therefore critical.

Current Information

There has been little effort to inventory Canada's protected cultural places systematically . Nor has there been much effort to define measures to assess the effectiveness of protective mechanisms. More fundamentally, there is little analysis of the degree to which the protection of cultural heritage sites serves the goal of sustainable development.

There are many laws and programs to protect cultural properties. For example, at the federal level, the Minister of the Environment may designate sites under his or her jurisdiction under the Historic Sites and Monuments Act. The Minister of the Environment is also empowered to designate sites under the Heritage Railway Stations Protection Act. And under the Federal Heritage Buildings Policy, all federal government buildings over 40 years old must be submitted for review, and may be classified by the Federal Heritage Buildings Review Office.

Because of the diversity of cultural heritage laws, there is no common set of standards, and no single complete inventory of cultural properties. Consequently, analysis of the state of protection afforded to such properties is currently impossible:

Systematic work needs to be done on an inventory and classification of cultural sites; on development of legislation and programs at all levels of government; and on a detailed review of threats from cultural trends, economic factors, and environmental influences. (SOE, 1991: p. 7-15)

Natural resource protection and restoration efforts are also extensive. For example, over 120 different government agencies and private programs are involved in acquiring and managing lands for conservation. Federal agencies or policies for restoration or protection activity include the Prairie Farm Rehabilitation Administration in Agriculture Canada; the Canadian Parks Sevice and the Water Survey of Canada in Environment Canada; the "no net loss" policy under Fisheries and Oceans; the National Forestry Statistics Project in Forestry Canada; the various land claim efforts which include the designation of parklands as well as the Water Resources and Land Management divisions in DIAND; and the Heritage Conservation Program Directorate in Public Works Canada.

Despite these initiatives, no comprehensive analysis of the ecological health of Canada's protected areas exists. The Canadian Parks Sevice recently completed a State of the Parks Report. However, this Report does not include information on provincial parks and conservation areas. A 1980 survey of the threats to national parks in the US demonstrates the value of such information for remedial action (National Parks Service, 1980).

More importantly, few protected area agencies in Canada have consistent environmental monitoring programs.

Most inventory and monitoring programs for protected areas require updating. To date, there is little research to indicate how well protected areas meet established conservation mandates, or even how to measure this criterion of effectiveness. (SOE, 1991: p. 7-19)

The situation concerning wildlife protection and rehabilitation is only slightly better. In 1976 federal, provincial and territorial wildlife agencies, together with three NGOs established a committee to assess and designate the levels of susceptibility of Canada's rare animals and plants. As of 1991, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) had reviewed and assigned status to 212 species, subspecies or populations of native wild animals and plants. Although an important start, this represents only a handful of the total number of species indigenous to Canada. In addition, the COSEWIC list excludes non-vascular plants and insects.

In 1988, government agencies established a strategy called Recovery of Nationally Endangered Wildlife (RENEW). RENEW requires a recovery plan for each species designated as endangered threatened or extirpated by COSEWIC within two years of its designation. Another important initiative is the North American Waterfowl Management Plan, a joint Mexican-US-Canadian initiative focusing on wetlands restoration. This plan complements the Permanent Cover Plan of the National Soil Conservation Program and operates in cooperation with Prairie Care, which addresses the conservation of agricultural resources and the environment, and the Crop Insurance Program, which deals with waterfowl damage compensation and prevention.

Finally, some data is available on a very general level. For example, The Statistics Canada publication, Human Activity and the Environment, estimates government expenditures on environmental and resource mitigation, and aggregates government gross revenues from natural resources and selected taxes directly related to environmental quality - such as gas taxes and water sales.

Issues and Recommendations

Current data are adequate to sketch conditions and trends. Progress is being made in the identification of endangered species and ecosystems. However, better policies will require better coordination of information between the many overlapping jurisdictions with influence over these issues. The recent Wetlands Policy Statement, issued by the Ontario Ministries of Natural Resources and Municipal Affairs is a good model of the type of inter jurisdictional effort required in this area. The Ministry of Natural Resources is responsible for mapping and classifying wetlands. Wetlands are classified on the basis of watercover, biological, social hydrological and special features. This information is then forwarded to municipalities. In turn, municipalities are expected to incorporate policies to protect provincially significant wetlands in official plans, zoning by-laws and other development decisions under the Planning Act.

5. CONCLUDING OBSERVATIONS

The shift in emphasis from the pursuit of separate policies (e.g., environmental protection, economic growth, health care, social equity) to a more integrated approach calls for new kinds of information to support decision-makers. It is information which enables decision-makers to anticipate and prevent environmental problems, which presents the full environmental and social, as well as economic costs of a particular action, which integrates measurements of ecosystem and human well-being and which measures changes in the quality of economic growth as well as in the quantity of goods produced and consumed. Increasingly, this information will have to be collected and assembled in a way that facilitates international comparisons, reflecting both the globalisation of issues and the need to measure progress across international frontiers.

According to Pearce and Freeman (1991), policy-makers promoting sustainable development need information which:

- is guided by an operational meaning of sustainable development;
- permits pressures on the environment, its state and environmental responses to stress to show through;
- enables the efficiency with which the economy processes environmental resources to be perceived;
- is guided by measures of importance, based on expert assessment of social cost and risk, and public opinion;
- is conducive to policy analysis -- in particular, it must be accompanied by information on the cost of any measures; and
- is reasonably "transparent" in terms of interpretation.

These needs have implications for the kind of information the government should collect, the way in which it should be presented and, by implication, for the way in which the government organises its information-gathering efforts.

Although the Canadian government has begun to redress many of the problems identified in this paper with respect to the quality and type of information currently collected, and with respect to existing collection processes, much work remains to be done to ensure that the information collected is used to measure Canada's progress towards more sustainable forms of development. The review of the information available to the federal government raises several issues, several of which are briefly described below.

1. Standards for sustainable development

The concept of sustainable development has yet to be defined in operational terms. Absent such a definition, it is not clear what data to collect, how to aggregate it, or how to interpret it. Much of the currently available information reflects the specific needs for which it was collected, and therefore may overlook issues previously not considered important and effects outside the jurisdiction being reported.

In 1990, the government committed itself to assessing the environmental implications of policy proposals submitted for cabinet consideration. This commitment has since been extended to policy and programme initiatives which do not reach cabinet. "Policy assessment", as this initiative has become known, cannot be conducted effectively without standards against which to judge whether a policy is environmentally acceptable or not. Policy assessment, therefore, is likely to lead government departments with sectoral responsibilities to define the environmental objectives they should meet. In time, policy assessment will force decision makers to seek, not only more environmental information, but also information which better integrates the various environmental and economic variables at issue.

2. Institutional fragmentation

Institutional fragementation is a problem both in how the government collects information and how it uses it. Most information collected by government agencies is assembled on the basis of jurisdictional considerations (e.g., administrative boundaries), rather than ecological parameters. This presentation makes it more difficult to integrate environmental and natural resource information, and this information with socio-economic information.

The processing power of computers provides new opportunities for analytical and integrative work. For this opportunity to be exploited fully, however, the government will have to define more clearly what it needs to know, and the quality of the data it collects. Environment Canada, Agriculture Canada and Forestry Canada are currently working at increasing the compatibility of the data they gather.

Environment Canada has also undertaken an integrated monitoring inititiative within its own department that is reexamining the way that it collects and stores data. Task groups have been set up to investigate ways in which monitoring data could be shared more easily within the Department, both from a technological and methodological perspective, and duplication in data collection reduced.

The barriers to the integration of information are often the result of institutional design leading both to jurisdictional fragmentation and regionally-different organisation, sometimes within the same department. For example, the Canadian Parks Service and the Canadian Wildlife Service maintain

geographically distinct regional organisations even though they have been part of the same department for the last decade. Institutional design may well turn out to be as important as the reconceptualisation of the needs of decision makers in ensuring that the government can integrate the information it gathers. In this regard, it is worth noting that an interdepartmental initiative is currently under way to standardise teh geographical boundaries used in reporting.

As the needs of decision makers change, it is increasingly clear that the current institutional design of many different agencies collecting environmental and natural resource information, each according to its own protocols, is no longer the most effective. This fragmentation of effort also raises questions concerning efficiency. In 1985, the Major Surveys Study Team pointed to the "growing need for the integration of natural resource and environment and socio-economic data to meet decision-making priorities in Canada". The Major Surveys Study Team proposed the consolidation of all major survey programs under the control of one federal minister to improve the efficiency and effectiveness of governmental data collection. There was no time to pursue the Study Team's proposal further in this overview. The continued fragmentation of the federal environmental information-gathering effort seven years after the Study Team's observations implies, however, that its proposal deserves further investigation.

Institutional design is an important consideration not only in the collection of information but also in its use as administrative arrangements can frustrate making full use of the environmental information available. Scientists at Environment Canada and the Department of Fisheries of Oceans, for example, are mandated to comment upon the presence and implications of toxic chemicals through every step of the food chain, except in the case of humans, where the Department of Health and Welfare is the lead agency responsible. Such an administrative distinction is purely artificial when it ignores ecosystemic relationships. It also fragments the research effort and, as a result, reduces the utility of the environmental information generated.

New administrative mechanisms (protocols?) will be required among agencies to facilitate the integration of information. In this regard, it is relevant to note that Statistics Canada is explicitly mandated to report its information publicly. As a service agency, it must be aware of its clients' needs and is driven in large part by them. Much of the natural resource information, on the other hand, is collected by government agencies to fulfill their own mandate. These needs are often defined from the "bottom-up" and are not client-driven. The fact that government decision-makers and information-gatherers often work in solitude, separated hierarchically and physically, compounds this problem. How to bridge the gap between them has long been an issue in science-based departments. It is becoming more urgent now that the needs of decision-makers are changing.

3. Scientific Uncertainty

Scientific and technological advances sometimes lead to situations where decision makers are "data-rich but information-poor". An example of this problem is our ability to measure minute traces of contaminants in the environment, including in food and human tissue, which outstrips our understanding of the significance of these concentrations.

The construction of many policy-relevant environmental indicators is not feasible because the underlying data do not exist: we do not know what the carrying capacity of certain ecosystems are, where thresholds may exist or the synergistic interaction among various stresses.

Environmental information, whether it concerns acid rain, global climatic change, the long range transport of air pollutants, or the assimilative capacity of a particular water body, is often ambiguous and leads to genuine differences of opinion among scientists. These differences carry obvious policy implications where large investments are at stake: Canada has already spent

hundreds of millions of dollars to abate emissions causing acid rain and would have to spend several tens of billions of dollars to reduce its carbon dioxide emissions by 20 percent by 2005, as many environmentalists and scientists propose.

Given the ambiguity which often exists on the significance of environmental information and the high economic stakes of acting on it, it is not surprising that both private and public decision makers have tended to interpret such information conservatively. The fact that environmental costs, beside often being uncertain, are almost always difficult to quantify, while the economic costs of mitigating environmental degradation can be calculated more easily, understandably biases an analysis of the trade-offs involved and militates against the application of the "precautionary principle".

4. Conceptual Problems

In 1984, the U.S. Council on Environmental Quality noted:

> ...Environmental scientists display an aversion to generalization, especially when it crosses disciplinary lines.... While economists use generalization to explain the complex, environmental scientists use complexity to avoid generalization. Environmental scientists focus on the unique. Much of their research involves the systematic measurement of unique events and situations. When they have enough information on a collection of unique events and situations, they make generalizations. But they never have enough. This professional perspective stands in the way of development of environmental indicators. Indicators are after all a form of generalization. (quoted in Sheehy, 1989).

Conceptual problems related to reporting on sustainable development include the use of appropriate discount rates (intergenerational issues) and the integration of economic and other non-priced data.

5. Cost

There are costs to collecting information. The databases government departments now use serve their needs. What incentive do they have to invest in reorganising this information in order to facilitate interdepartmental integration at a time of budgetary cutbacks? Until their mandates are explicitly redefined to promote sustainable development, and the government as a whole addresses the institutional and resource consequences of such a redefinition, individual agencies will continue to give priority to information that serves their own needs.

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